

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1 (currently amended). A computer-readable storage medium having encoded thereon computer-executable instructions to perform a method of creating shadow pages for an address translation map, the address translation map comprising a page directory and a plurality of page tables, the page directory comprising links to the plurality of page tables, each of the page tables comprising links to a plurality of data pages, the page directory and page tables each being stored in one of the data pages, the method comprising:

for at least one of the plurality of page tables, creating a first shadow page table based on said one of the plurality of page tables, said first shadow page table differing from said one of the plurality of page tables in at least one of the following respects:

at least one entry in said first shadow page table links to a different data page than that entry's corresponding link in said one of the plurality of page tables; and

said first shadow page table contains one or more read-only links whose corresponding links in said one of the plurality of pages tables are read/write; and

creating a shadow page directory based on the page directory, the page directory comprising a link to said one of the plurality of page tables, said shadow page directory comprising a link to said shadow page table instead of the link to said one of said plurality of page tables,

wherein an item of software uses said page table to perform a non-address-mapping action that depends, for correct operation of said item of software, on data being present, in said one of said plurality of page tables, that said item of software has previously written to said one of said plurality of page tables and that said item of software expects to be present in said one of said plurality of page tables, that has said data having a characteristic that is present in said one of the plurality of page tables but not present in said first shadow page table, wherein said first shadow page table is used to translate addresses for said item of software and said one of the plurality of page tables is not used to translate addresses for said item of software.

2 (currently amended). The computer-readable storage medium of claim 1, wherein a policy governs access to a memory, wherein access to said memory based on said address

translation map applied to said virtual address results in violation of said policy, and wherein access to said memory based on said shadow page directory and said first shadow page table being applied to said virtual address does not result in violation of said policy.

3 (currently amended). The computer-readable storage medium of claim 1, wherein each of the data pages is stored at a particular frame of a memory, wherein said page directory is stored at a first frame, and wherein the method further comprises:

maintaining a copy of said page directory at a second frame different from said first frame; and

storing the shadow page directory at said first frame.

4 (currently amended). The computer-readable storage medium of claim 1, wherein said page directory comprises a link to a first-sized page, said first-sized page comprising a plurality of second-sized pages, and wherein the method further comprises:

creating a second shadow page table that comprises links to said plurality of second sized pages, wherein said shadow page directory comprises a link to said second shadow page table.

5 (currently amended). A system for managing the use of a memory comprising:

a memory comprising a plurality of individually-addressable components that can be read and written, each of the individually-addressable components having a physical address associated therewith;

an address translation data structure that defines a mapping between virtual addresses and the physical addresses of the individually-addressable components;

a memory manager that receives a request to access a first one of the individually-addressable components, said request identifying said first one of the individually-addressable components based on a virtual address, said memory manager translating said virtual address into the physical address of said first one of the individually-accessible components based on data that comprises a shadow representation of said address translation data structure, there being an item of software that uses said address translation data structure to perform a non-address-mapping action that depends, for correct operation of

said item of software, on data being present, in said address translation structure, that said item of software has previously written to said address translation structure and that said item of software expects to be present in said address translation structure, ~~that has~~ said data having a characteristic that is present in said address translation structure but not present in said shadow representation of said address translation structure, wherein said shadow representation of said address translation structure is used to translate addresses for said item of software and said address translation structure is not used to translate addresses for said item of software.

6 (previously presented). The system of claim 5, wherein said memory is organized into a plurality of pages, said first one of the individually-addressable components being located within one of said plurality of pages, wherein said address translation data structure comprises: (1) a plurality of page tables that contain links to said plurality of pages, and (2) a page directory that contains links to said plurality of page tables, and wherein said shadow representation of said address translation data structure differs from said address translation data structure with respect to at least one link.

7 (previously presented). The system of claim 6, wherein each of the links contained in said page directory and said page tables contains one or more attributes, and wherein at least one link in said shadow representation differs from a corresponding link in said address translation data structure with respect to at least one attribute.

8 (original). The system of claim 6, wherein the page directory and each of the page tables is stored in one of said plurality of pages, each of the pages having a physical location descriptor associated therewith, each of the links in the page directory and page tables identifying one of the pages based on the physical location descriptor.

9 (original). The system of claim 8, wherein said shadow representation includes an alternative version of at least one of said page directory or one of said page tables, and wherein said alternative version is stored at a page having a different physical location descriptor from the page on which the alternative version is based.

10 (previously presented). The system of claim 5, wherein a policy governs the accessibility of the memory, wherein the address translation data structure, exposes the memory to violation of the policy, and wherein the system further comprises:

a memory access control manager that creates the shadow representation based on the address translation data structure and ensures that the shadow representation, if used to access the memory based on virtual addresses, does not result in violation of the policy.

11 (original). The system of claim 10, wherein the policy defines a portion of the memory as inaccessible, and wherein the memory access control manager ensures that the shadow representation does not expose a virtual address for said portion of the memory.

12 (original). The system of claim 10, wherein the policy defines a portion of the memory as being readable but not writeable, and wherein the memory access control manager ensures that the shadow representation contains one or more attributes that mark the portion of memory as being read-only.

13 (previously presented). The system of claim 10, wherein the memory access control manager ensures that the shadow representation contains one or more attributes that mark as read-only those portions of the memory that store at least one of: (1) the address translation data structure; and (2) the shadow representation.

14 (currently amended). A method of executing a memory access request comprising:
receiving an request to read or write a unit of a memory, said request
identifying said unit of said memory based on a virtual address;

accessing said unit of memory based on a representation of a map that defines a relationship between virtual addresses and physical addresses, said map being stored in one or more pages of said memory, said representation of said map comprising at least one shadow page that is based on a first one of said one or more pages, said map including at least one aspect which, if used to access said memory based on said virtual address, would result in violation of a memory access policy, said shadow page differing from said first one of said one or more pages in a manner such that use of said representation of said map to access said

memory based on said virtual address does not violate said memory access policy, there being an item of software that uses said first one of said one or more pages to perform a non-address-mapping action that depends, for correct operation of said item of software, on data being present, in said first one of said one or more pages, that said item of software has previously written to said first one of said one or more pages and that said item of software expects to be present in said first one of said one or more pages, that has said data having a characteristic that is present in said first one of said one or more pages but not present in said shadow page, wherein said shadow page is used to translate addresses for said item of software and said first one of said one or more pages is not used to translate addresses for said item of software; and

performing the read or write specified in said access request.

15 (original). The method of claim 14, wherein said memory access policy defines a portion of said memory as being inaccessible, wherein said map exposes writeable links to portions of said memory that define virtual address mappings, and wherein said representation of said map does not expose writeable links to portions of said memory that define virtual address mappings.

16 (original). The method of claim 14, wherein said map comprises: (1) a plurality of tables that contain links to a set of said one or more pages, and (2) a directory that contains links to said plurality of tables, said at least one shadow page comprising a shadow directory that differs from said directory in at least the respect that at least one link in the shadow directory points to a shadow page table instead of to one of said plurality of tables.

17 (original). The method of claim 14, wherein said map comprises a plurality of tables that contain links to a set of said one or more pages, wherein said shadow page comprises a representation based on one of said tables, and wherein said shadow page contains a representation of a first link that exists in said one of said tables, wherein said first link is a read/write link in said one of said tables, and wherein said shadow page differs from said one of said tables in that said shadow page's representation said first link is marked read-only.

18 (original). The method of claim 14, wherein said shadow page comprises a directory, wherein said unit of memory is encompassed by a first-sized page that comprises a plurality of second-sized pages, wherein said map comprises a directory that contains a link to said first-sized page, wherein said shadow page is based on said directory, and wherein said shadow page differs from said directory in that said shadow page contains a link to a table instead of a link to said first-sized page, wherein said table contains links to second-sized pages that are included within said first-sized page.

19 (currently amended). A computer-readable storage medium having encoded thereon a data structure that is representative of an address translation map, the address translation map comprising a page directory, the directory comprising links to a plurality of page tables, each of the page tables being stored at a particular frame within said computer-readable medium, each of the page tables comprising links to a plurality of pages of said computer-readable medium, the data structure comprising:

a shadow page table that is based on a first one of the plurality of page tables;

a shadow page directory that is based on the page directory, the page directory comprising a first entry that contains a link to said first one of the plurality of page tables, said shadow page table comprising a second entry that corresponds to the first entry, said second entry containing a link to said shadow page table instead of a link to said first one of the plurality of page tables, there being an item of software that uses said first one of the plurality of page tables to perform a non-address-mapping action that depends, for correct operation of said item of software, on data being present, in said first one of the plurality of page tables, that said item of software has previously written to said first one of the plurality of page tables and that said item of software expects to be present in said first one of the plurality of page tables, that has said data having a characteristic that is present in said first one of the plurality of page tables but not present in said shadow page table, wherein said shadow page table is used to translate addresses for said item of software and said first one of the plurality of page tables is not used to translate addresses for said item of software.

20 (currently amended). The computer-readable storage medium of claim 19, wherein the first of the plurality of page tables is stored at a first frame, wherein the shadow page

table is stored at a second frame, and wherein the shadow page directory differs from the page directory in the respect that a link in the page directory contains an identifier of said first frame and the corresponding link in the shadow page directory contains an identifier of said second frame.

21 (currently amended). The computer-readable storage medium of claim 19, wherein said first of said plurality of page tables contains a link to a first one of the pages, wherein said shadow page table contains a link to a representation based on said first one of the pages instead of the link to the first one of the pages, said representation based on said first one of the pages being stored at a frame different from said first one of the pages.

22 (currently amended). The computer-readable storage medium of claim 21, wherein said first one of the plurality of pages stores either the page directory or said first one of the plurality of page tables.

23 (currently amended). The computer-readable storage medium of claim 22, wherein said first one of the plurality of page tables contains a link that specifies said first one of the plurality of pages as being readable and writeable, and wherein the corresponding link in said shadow page table specifies said first one of the plurality of pages as being only readable.

24 (currently amended). The computer-readable storage medium of claim 19, wherein the page directory and said first one of the plurality of page tables contain at least one feature such that, if used to access a memory based on a virtual address, would result in a violation of a memory access policy, and wherein the shadow page directory and shadow page table contain data such that accessing the memory through said shadow page directory and said shadow page table based on said virtual address does not result in violation of said memory access policy.